CURRICULAR NEEDS OF SHIPYARD PROFESSIONALS

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NATIONAL SHIPBUILDING RESEARCH PROGRAM

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16. Abstract

A study of U.S. shipyards was conduct to identify the knowledge and skills required of entry-level graduate professionals in the design, engineering, planning, and production functions. Information was gathered through questionnaires and interviews with shipyard management representatives It was found that most graduate professionals entering the shipbuilding industry are engineers who have no prior marine or industrial training or experience. Further, roost engineering graduates entering the shipbuilding industry lack (1) needed skills in oral and written communication, and (2) needed knowledge of business subjects. production processes, and supervisory techniques. A major conclusion of the study is that additional cooperative engineering curricula need to be established, so that engineering students can acquire broader knowledge and skills through periodic work and/or research assignments in shipyards. Recommendations concerning other curricular changes include addition of certain courses now usually absent--in statistics, materials and metallurgy, production processes, principles of supervision, and engineering economics, along with an increase in realistic exercises in written communications throughout the four or five years of undergraduate studies. A recommended five-year cooperative engineering curriculum for shipbuilding engineers is included .

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FOREWORD

U. S. shipyards are faced with significant barriers to an increased share of the commercial shipbuilding market. High labor costs, long lead times for material, and an inability to secure a steady flow of orders has placed American shipbuilding firms in a disadvantageous position with respect to their foreign competition. However, these barriers are not insurmountable. In fact, the problem of high labor costs has been a historic disadvantage which, until recently, was overcome by a significant American lead in labor productivity.

Through the National Shipbuilding Research Program, the U. S. shipbuilding industry has been regaining its lead in productivity and, hence, its competitive position. New technologies have been developed or transferred from the leading shipbuilding countries such as Japan.

Capital investment, methods enhancement, and technology transfer have significantly improved the competitive position of U. S. shipyards. Yet there is still a long way to go.

Education and training is a low-investment, high-return area for improving productivity and overcoming the barrier of high labor costs. The effective use of new technologies and the implementation of new capital requires a well educated, innovative cadre of technical and managerial personnel to ensure a continued increase in productivity in this country. With the support of the Ship Production Committee's Education Panel, this report investigates the pre-entry curricular needs of the professionals who will be charged with increasing productivity in the shipbuilding industry. In particular, this report presents a model five-year cooperative engineering curriculum for shipbuilding engineers designed to support the increased use of advanced technology and capital investment.

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1.0 INTRODUCTION

This report describes a study undertaken to identify the knowledge and skills required of engineering graduates entering the shipbuilding industry. The project was supported by the Maritime Administration, U.S. Department of Transportation, through a contract with the Education Panel of the Ship Production Committee, The Society of Naval Architects and Marine Engineers. A concern of the Ship Production Committee is that engineering curricula at most U.S. colleges and universities are not well suited to the needs of the shipbuilding industry.

The study used mail-survey questionnaires and personal and telephone interviews with shipyard management personnel to identify types of graduate professionals in shipyards, the kinds of work they are performing, knowledge and skills needed in entry-level engineers, deficiencies commonly found in recent graduates, current educational and training programs, and future curricular and training needs.

While efforts were made to include in the survey all 24 of the U.S. shipyards identified by the Maritime Administration as constituting the base of the U.S. shipbuilding industry, comprehensive survey and interview data were obtained from only some of those shipyards (see Table 1). Nonetheless, the participating shipyards constitute a fairly representative mix of larger and smaller shipyards on the East, West, Great Lakes, and Gulf coasts, and opinions of their management concerning the educational needs of entering engineers are probably reasonably representative of the industry as a whole.

Table 1

U.S. Shipyards Surveyed in the Study

Shipyards in Survey	Responded to Survey of Graduate Professional Employment	Responded to Survey of Super-visory Training	Respondent to Telephone Survey of Curricular Needs
Alabama Dry Dock & Shipbuilding Co. Mobile, Alabama	x		
American Ship Building Co. Tampa, Florida			
Avondale Shipyards, Inc. New Orleans, Louisiana	x		x
Bath Iron Works Corporation Bath, Maine			
Bay Shipbuilding Corporation Sturgeon Bay, Wisconsin	x	x	
Bethlehem Steel Corporation Sparrows Point Yard Sparrows Point, Maryland			
Boeing Marine Seattle, Washington		x	
Electric Boat Groton, Connecticut			x
FMC Corporation Portland, Oregon			
Ingalls Iron Works Company Pascagoula, Mississippi	x	x	x
Levinston Shipbuilding Company Orange, Texas			
Lockheed Shipbuilding and Construction Company Seattle, Washington		x	x
Marinette Marine Corporation Marinette, Wisconson	x	x	

Tablel (continued)

Shipyards in Survey	Responded to Survey of Graduate Professional Employment	Responded to Survey of Super-visory Training	Responded to Telephone Survey of curricular Needs
Maryland Shipbuilding and Dry Dock Company Baltimore, Maryland	x		
McDermott Shipyard Group New Orleans, Louisiana	x	x	
National Steel and Shipbuilding Company San Diego, California	x	x	x
New port News Shipbuilding and Dry Dock Company Newport News, Virginia		x	x
Norfolk Shipbuilding and Dry Dock Company Norfolk, Virginia	x		x
Penn Ship Chester, Pennsylvania			
Peterson Builders, Inc. Sturgeon Bay, Wisconsin		x	x
General Dynamics - Quincy Shipbuilding Division Quincy, Massachusetts			x
Tacoma Boatbuilding Company Tacoma, Washington		x	
Tampa Ship Repair and Dry Dock Tampa, Florida			
Todd Pacific Shipyards Corp. San Pedro, California	x	x	x

2.0 GRADUATE PROFESSIONAL EMPLOYMENT

The shipyards were asked to furnish statistics on numbers of graduate professionals employed, classified by kind of degree and functional work areas--design, planning, production, accuracy control, and other. Comparative figures from individual shipyards could have been presented here, but several of the shipyards participated only on condition that they not be identifiable in this report. Moreover, the shipyards varied considerably in their departmental nomenclature, and numbers of hourly employees changed significantly at some yards during the study period. Thus, for those reasons, the numbers of graduate professionals employed at the ten responding yards were pooled (see Table 2).

Table 2

Employment of Graduate Professionals in Ten U.S. Shipyards

Degree	Number	Percent of Total Employment of Approx. 40,000	Number of Shipyards Employing Graduates
Business Administration or Management	201	.50	10/10
Mechanical Engineering	193	.48	10/10
Electrical Engineering	109	.27	10/10
Naval Architecture	103	.26	10/10
Mathematics	62	.16	3/10
Marine Engineering	57	.14	9/10
Industrial Engineering	49	.12	7/10
Civil Engineering	46	.12	9/10
Computer Science	16	.04	5/10
Structural Engineering	15	.04	7/10
Other	359	.90	
Total	1210	3.03%	

Among the 1210 graduate professionals employed in the ten shipyards, 82 percent have a bachelors degree, 12 percent a masters, and two percent a Ph.D. The other five percent have an associate degree (two-year certificate) of some kind, most commonly in business administration or computer science. Among graduates with a degree in engineering, mathematics, or physical science, 64 percent were working in the design function, 23 percent in production, 10 percent in planning, and three percent in accuracy control.

Of the 746 engineers and scientists surveyed, only 20 percent are naval architects or marine engineers. Those are the only degree programs that have any significant content directed specifically towards ship production. This means that the other 80 percent of the entry-level technologists most likely have not been exposed to the shipbuilding industry (and its products, processes, terminology, etc.) prior to graduation.[1]

The shipbuilding industry employs only a small percentage of the total number of engineers graduating today. According to Davis [5][2], the shipbuilding industry can expect to hire a significant proportion of the graduating naval architects and marine engineers, but only a small percentage of other types of engineering graduates. Of the engineering disciplines of mechanical, electrical, chemical, and metallurgical, the shipbuilding industry should expect to hire less than two percent of the total graduates. Therefore, curriculum development designed to support the shipbuilding industry must reflect the needs of other industries in order to be adapted as a norm for engineering graduates in the disciplines of mechanical engineering, industrial engineering, civil engineering, etc.

Not so according to Table #2

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[1]An undetermined number of students may enter the industry following temporary shipyard employment as work study employees or may be involved in cooperative education programs.

[2]Numbers in brackets designate references at the end of the report.

3.0 OPINIONS OF SHIPYARD MANAGEMENT REGARDING ENGINEERING CURRICULA

To obtain opinions of shipyard management personnel concerning the knowledge and skills needs for entry-level engineers, a telephone survey was conducted with 16 managers in ten shipyards. All were working as supervisors or managers--ten of them in design, three in production, two in planning, and one in accuracy control. (That distribution closely matches the mail-survey findings concerning the employment distribution of engineering graduates in shipyards.) Four of the 16 had masters degrees, and most of them had worked in the industry for more than a decade.

The telephone survey had two parts. In the first, the respondents were asked to rank 38 college subjects in eight areas (mathematics, basic sciences, engineering sciences, computer sciences, communication, social sciences, humanities, and business) on a scale of one (Not At All Important) to five (Very Important). The average rankings of those subjects within each category are shown in Table 3. As Table 3 indicates, technical and business writing was considered very important by the respondents.

Table 3

Relative Importance of College Subjects Within Eight Categories As Ranked by Shipyard Executives (Scale: l=Not Very Important; S=Very Important)

Category/Subject	Avg.
Communication	
Technical/Business Writing	4.9
Public Speaking	3.9
Mathematics	
Analytical Geometry	4.6
Calculus	4.6
Linear Algebra	4.4
Statistics	4.0
Differential Equations	3.9
Probability	3.6
Advanced Mathematics	3.1
Business	
Engineering Economics	4.3
Management	4.2
Supervision	4.1
Accounting	3.3
Engineering Science	
Production Processes	4.6
Structures	4.4
Statics	4.3
Dynamics	4.1
Welding	3.9
Drafting	3.8
Numerical Control	3.8
Fluid Mechanics	3.6
Materials & Metallurgy	3.6
Electrical Circuits	3.5
Fluid Dynamics	3.3
Thermodynamics	3.2
Computer Science	
CAD/CAM	3.9
Programming	3.8
Database Management	3.7
Data Processing	3.0
Basic Science	
Physics	4.4
Chemistry	2.9

Table 3--continued

Category/Subject	Avg.
Social Sciences	
Economics	3.9
Psychology	2.9
Sociology	2.9
Political Science	2.3
Humanities	
Literature	3.1
Art	2.7
Music	1.8

Table 4 presents all 38 subjects by average and relative rankings.

Table 4

Meal Rankings of 38 College Subjects
by Shipyard Executives

Subject	Average **Rank**	Relative Priority
Technical/Business Writing	4.9	1
calculus	4.6	2
Analytical Geometry	4.6	2
Production Processes	4.6	2
Physics	4.4	5
Structures	4.4	5
Linear Algebra	4.4	5
Engineering Economics	4.3	8
Statics	4.3	8
Managemenmt	4.2	10
Supervision	4.1	11
Dynamics	4.1	11
Statistics	4.0	13
CAD/CAM	3.9	14
Differential Equations	3.9	14
Welding	3.9	14
Economics	3.9	14
Public Speaking	3.9	14
Numerical Control	3.8	19
Drafting	3.8	19
Programming	3.8	19
Database Mgt	3.7	22
Fluid Mechanics	3.6	23
Materials & Metallurgy	3.6	23
Probability	3.6	23
Electrical Circuits	3.5	26
Fluid Dynamics	3.3	27
Accounting	3.3	27
Thermodynamics	3.2	29
Literature	3.1	30
Advanved Math	3.1	30
Data Processing	3.0	30
Psychology	2.9	33
Sociology	2.9	33
Chemistry	2.9	33
Art	2.7	36
Political Science	2.6	37
Music	1.8	38

Scale: l=Not Very Important; 5=Very Important

In the second part of the telephone survey, the respondents were asked to rate each of the 38 subjects in terms of whether, in their experience, entry-level engineers have sufficient knowledge of that subject to perform effectively in the Shipbuilding industry. Their responses were then matched with the prior responses that ranked the importance of the subjects. This process identified problem areas--i.e., subjects that are considered important and in which entry-level engineers have insufficient knowledge. The results are shown in Table 5, where a rating of more than 2.0 denotes a problem subject. A rating of less than 2.0 denotes a subject in which entering engineers are adequately prepared.

Table 5

College Subjects Rated According to Their Importance and the Adequacy of Entry-Level Engineers' Knowledge of Them

Category/Subject	Avg.
Communication	
Technical/Business Writing	2.7
Public Speaking	2.5
Mathematics	
Analytical Geometry	1.8
Calculus	1.8
Linear Algebra	1.6
Statistics	2.5
Differential Equations	2.0
Probability	2.3
Advanced Mathematics	2.3
Business	
Engineering Economics	2.3
Management	2.7
Supervision	2.5
Economics	2.4
Engineering Sciences	
Production Processes	2.9
Structures	2.0
Statics	2.0
Dynamics	2.1
Welding	2.6
Drafting	1.9
Numerical Control	2.6
Fluid Mechanics	2.1
Materials & Metallurgy	2.5
Electrical Circuits	2.0
Fluid Dynamics	2.1
Thermodynamics	1.9
Computer Sciences	
CAD/CAM	2.6
Programming	2.0
Database Management	2.5
Data Processing	2.1
Basic Sciences	
Physics	2.3
Chemistry	2.1

Scale: Ratings of more than 2.O=inadequate knowledge

As indicated by ratings significantly higher than 2.0 in Table 5, the survey respondents regarded entry-level engineers as lacking sufficient knowledge and skills in several subjects they considered important for work in the shipbuilding industry. In the area of communication, the problem subjects were technical and business writing as well as public speaking. In the area of engineering sciences relating to manufacturing, several subjects were problems: production processes, welding, numerical control, and materials and metallurgy. In the area of business subjects, entering engineering graduates were considered inadequately prepared in supervisory and management principles, techniques, and skills. In the area of computer sciences, graduates were considered unprepared in principles and techniques of computer-assisted design, computer-assisted manufacturing, and database management. Those findings are discussed in the next section.

3.1 Discussion ofProblem Areas

In this section the three problem areas found--inadequate knowledge and skills in communication, manufacturing, and management subjects--are discussed in terms of their origins and confinement or lack of confinement to the shipbuilding industry.

3.1.1 Communication. The problem of engineering graduates not being able to communicate effectively in writing, and, to a lesser extent , in public speaking, is evidently widespread and not confined to the shipbuilding industry. The literature on this topic indicates that American industry, in general, rates engineers high in technical skills and deficient in conununication skills [12, 19, 21, 25, 26]. This discrepancy is illustrated in the results of a survey reported by Lyons [12] and shown here in Table 6.

Why are most engineering graduates unable to write effective memos, proposals, and reports? The literature on this problem [9, 10, 17, 18, 20, 25, 29] and comments from our survey respondents indicate that engineering students do not get enough supervised experience in solving the kinds of communications problems posed by their work situations in the industrial positions they enter upon graduation from college. Too

Table 6

Responses to the Question:
"How would you rate the following
skills of recent mechanical engineering graduates?"

Skill	Superior	Average	Marginal	Observation
Verbal	9%	63%	26%	2%
Written	3%	40%	51%	6%
Analytical	51%	43%		6%

Data Base: 33 companies
source: Lyons, H. [12]

few newly graduated engineers are able to solve the practical rhetorical problems (defining the audience, judging the needs of that audience, designing an effective message in both form and substance). Moreover, too few engineers have received enough expert, personal, detailed feedback on their writing to have learned enough about effective diction, syntax, sentence structure, paragraph structure, and paragraph sequencing--not to mention the simple mechanics of spelling and punctuation. Thus most engineers evidently emerge from colleges (and, often, graduate schools) scientifically and mathematically literate but rhetorically and linguistically illiterate.

Obviously the basic engineering curriculum needs to be changed to offer engineering students more extensive coursework and high-quality feedback on rhetorical and linguistic errors they are making in writing assignments closely matching the kinds they will be encountering in industry. Another potential solution is available with cooperative curricula--campus study alternated with periods of work in the shipbuilding industry. Shipyard work or research assignments offer students and shipyard management excellent opportunities to work with instructors of rhetoric, wherein the student is guided in selecting a report topic, designing and writing the report, obtaining multiple critiques, and then redesigning and rewriting the report. The combination of evidence from industry spokesmen, engineering students, and the research literature suggests that nothing less than extensive, realistic, supervised practice jam-packed with expert feedback will solve the problem. Whether engineering schools can or will rise to that challenge is another question.

3.1.2 Manufacturing. Problem subjects identified in the area of manufacturing techniques--production processes, welding, numerical control, CAD/CAM, and materials and metallurgy--are unlike writing problems, in that they stem more directly from the particular concerns of the shipbuilding industry. But some of those subjects are also problem areas for other industries [23]. Graduate engineers lack basic knowledge of manufacturing processes and, in particular, the effects materials have on a process and vice versa. The subject of production processes (including welding and numerical control) is not required in more than 50 percent of all mechanical engineering curricula [12]. Additionally, many curricula do not require a course in materials and metallurgy. A working knowledge of CAD/CAM requires a fundamental knowledge of manufacturing; therefore, CAD/CAM is a related problem area.

One proposed solution [23] to this problem is to require a three-term sequence in materials and metallurgy, manufacturing processes, and mechanical design (with an emphasis on material applications).

3.1.3 Management. Problem subjects grouped here under the general heading of management all relate in one way or another to management decision-making: management, supervision, accounting, engineering economics, statistics, probability, and database management. As with the problem of written communication, the inadequate preparation of engineering graduates in the area of management and supervisory techniques is not confined to the shipbuilding industry [12, 21, 26]. Most engineering curricula do not include required courses in accounting, management, or supervision. Moreover, engineering economics, probability, and statistics are required subjects in engineering curricula at only a few institutions. One survey of mechanical engineering curricula indicates that only one-third of them require a course in engineering economics, and only one-seventh require a course in statistics [12]. The effects of a lack of understanding of business and cost factors in the engineering decision-making process has been identified by the Task Force on Engineering Education, National Academy of Engineering, as a factor in the decline of American industrial productivity [21]. Therefore, a strong program in management should complement the engineering sciences.

3.2 Need for Engineering Specialties

The respondents in the telephone survey and interviews discussed not only weaknesses in basic engineering curricula but the need in their industry for engineers with specialized education in several areas, as follows:

Dynamics. Because of the way ships are designed, constructed, and operated, the industry requires experts who can handle a wide range of problems in dynamic analysis, including seakeeping, mechanical vibrations, structural vibrations, and shock analysis.

Plate Theory. The modern ship design process requires experts capable of analyzing the mechanics and dynamics of plates and shells.

Hydrodynamics. As interest in fuel conservation has increased, hull form and propeller dynamics have become increasingly important in the shipbuilding industry.

Computing. The increasing reliance on computers in almost all phases of shipbuilding requires engineers who have special knowledge of programming, automatic data processing, computer-aided design, and computer-aided manufacturing.

Electronics. The increasing sophistication of shipboard electronic systems and equipment in both civil and military ships requires electronic specialists capable of designing and integrating systems, supervising installation, and conducting qualifying tests.

Naval Architecture. Naval architects will continue to be needed for basic design functions involving form, stability, powering, maneuverability, economics, etc.

Welding. Inasmuch as welding constitutes the largest cost center in ship construction, the industry needs welding engineers to review and up-grade joint designs and welding practices in the interests of ensuring high quality, improving productivity and decreasing costs.

Industrial Engineering. Specialists in industrial engineering are needed to improve shipyard productivity by devising new means of integrating men, materials, and machines in a rapidly changing technological environment. For a discussion of industrial engineering training specifically for the shipbuilding industry, see reference 30.

3.3 Recommended Five-Year Cooperative Engineering Curriculum

Based on information obtained from the surveys and from the professional literature on engineering curricula [5, 7, 9, 12, 17, 21, 27, 30, 31], a model five-year cooperative engineering curriculum was developed and is presented here. The required courses listed, along withh indicated periods of industrial work experience, are intended to eliminate currently perceived weaknesses in basic engineering curricula, while the electives listed offer students the opportunity to master specialties particularly important to the shipbuilding industry.

The key to this recommended curriculum is the three terms of industrial work experience. During each work period, the student should be assigned to an experienced engineer and be given a research topic. The student would then be required to work with the assigned engineer and an instructor of rhetoric to produce a technical report of the highest quality in form and content. The three assignments should also expose the student to many different aspects of the ship design and construction process. Therefore, the assignments are in three areas: one term each in production, planning, and engineering. The three work assignments are designed to complement the curriculum. Each work assignment should be based on the abilities of the student and the portion of the curriculum completed to date.

Recommended Five-Year Cooperative Engineering Curriculum

	Required Courses	Elective Courses
Year 1	Linear Algebra Calculus I Calculus II Drafting Programming and Data Processing Chemistry Physic I Composition Public Speaking	Humanities or Social Science
Year 2	Analytical Geometry Differential Equations Technical Writing Mechanics of Solids (Statics and Structures) Dynamics Thermodynamics Materials & Metallurgy Physics II SUMMER WORK ASSIGNMENT: Production	Humanities or Social Science Technical Elective Technical Elective
Year 3	Introduction to Probability and Statistics Manufacturing Processes Accounting Engineering Economics Electrical Circuits Fluid Mechanics Business Writing for Engineers II SUMMER WORK ASSIGNMENT: Planning	Humanities or Social Science Advanced Mathematics Technical Elective Technical Elective
Year 4	CAD/CAM Production Engineering Management & Supervision for Engineers SUMMER WORK ASSIGNMENT: Engineering	Humanities or Social Science Mathematics Elective Technical Elective Technical Elective
Year 5	Database Management Technical and Business Writing for Engineers III Design I Design II	Humanities or Social Science Technical Elective Technical Elective Technical Elective Technical Elective

Technical Electives

Year 2	Ship Form Calculations & Stability
Year 3	Structural Analysis Mechanical Vibrations Power systems Fluid Dynamics Ergonomics Thermodynamics
Years 4 & 5	Energy Methods in Structural Analysis Theory of Elasticity Theory of Plates & Shells Finite Element Methods Control Systems Heat Transfers Thermodynamics III Hydrodynamics Welding Numerical Control Statistical Quality Control Production Control Ship Production Work Measurement Robotics Computer Graphics Information Systems Safety Management

4.0 SHIPYARD SUPERVISORY TRAINING

It was assumed that administrative positions in a shipyard are not dissimilar to positions in related industries [6,15]. Therefore, this section concentrates on training needs of first-line and middle management.

In addition to the survey of graduate professional employment and of curricular needs, shipyards were asked to provide information on in-house and local training programs available to foremen, supervisors, and managers. The in-house courses offered by the 11 responding shipyards are shown in Table 7.

In addition to the courses offered directly by the eleven shipyards, two of the yards have a cooperative arrangement with local educational institutions. Newport News Shipbuilding and the Thomas Nelson Community College have a cooperative program of 15 courses leading to a Certificate of Industrial Management. It is available to all supervisors. The curriculum is shown in Table 8.

The second shipyard having a cooperative program is Marinette Marine. Its supervisors can earn an associate degree in management from nearby Northwest Wisconsin Technical Institute by completing the courses listed in Table 9.

While many shipyards may not find it feasible to set up a cooperative education program for Supervisors at nearby colleges or junior colleges, those that can do so should ensure that the curriculum contains certain courses regarded as important by the survey respondents and also researchers in that field [9, 15, 30]. Recommended courses for a curriculum leading to an associate degree in management for shipyard supervisors are listed in Table 10.

Table 7

In-House Supervisory Training Courses
for Foremen, Supervisors, and Managers

	Company Policy	Employee Relations	Communication Skills	Safety	Methods Analysis	Mgmt. Techniques	Computerized Mgmt. Info. Systems	Planning & Scheduling	Business Admin.	Quality Control	Motivation
BAYSHIP		x	x	x		x				x	
Boeing Marine	x	x		x		x					
Ingalls	x	x					x	x			
Lockheed	x	x	x	x	x	x	x	x	x	x	x
Marintte Marine	x	x	x	x	x			x	x	x	x
McDermott	x	x	x	x	x	x		x		x	x
NASSCO	x	x	x	x		x		x			x
Newport News	x	x	x	x	x	x		x		x	x
Peterson Builders	x	x		x		x		x			x
Tacoma Boat	x	x		x	x						
Todd Pacific	x	x	x	x	x	x				x	x

Table 8

Curriculum for
Certificate in Industrial Management
Thomas Nelson Community College
Newport News, Virginia

First Quarter	Second Quarter	Third Quarter
Accounting I	Accounting II	Accounting III
Human Relations & Leadership	Coop. Education in Bus. Mgt.	Coop. Education in Bus. Mgt.
Intro. to Labor Relations	Data Processing	Personnel Mgt.
Coop. Education in Bus. Mgt.	Methods of Manufacture I	Economics I
Communication in Business and Industry	Organizational Communication	Occupational Safety

Table 9

Curriculum for
Associate Degree in Management
Northwest Wisconsin Technical Institute
Marinette, Wisconsin

First Semester	Second Semester	Third Semester
Principles of Supervision	Personnel Practices	Managing Human Resources
Making Meetings Work	Time Management	Economics I
Human Dynamics	Communication I	

Fourth Semester	Fifth Semester	Sixth Semester
Labor Relations	Safety	Affirmative Action
Engineering Agreements	American Institutions	Tech Math -or- Accounting and Statistics

Seventh Semester
Leadership
Occupational Trends and Issues

Table 10

Recommended Courses for
Associate Degree in Management for
Supervisors in Shipyards

Accounting	Labor & Personnel Relations I
Business Administration	Labor & Personnel Relations II
Computerized Management Information Systems	Communications I
Data Processing	Communications II
Principles of Supervision	Quality Control
Management Techniques	Manufacturing processes
Occupational Safety	
Economics	

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